

**Methods for Testing and Specification (MTS);  
Internet Protocol Testing (IPT): IPv6 Security;  
Conformance Abstract Test Suite (ATS) and partial Protocol  
Implementation eXtra Information for Testing (PIXIT) proforma**

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**Reference**DTS/MTS-IPT-011-IPV6-secATS

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**Keywords**IP, IPv6, security, testing, TTCN

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## Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Methods for Testing and Specification (MTS).

---

# 1 Scope

The present document specifies the Abstract Test Suite (ATS) for the mobility functions of the Internet Protocol, Version 6, as defined in the specifications [11] through to [14]. The ATS is based on the requirements defined in the IPv6 requirements catalogue (TS 102 558 [2]) and the IPv6 test purposes (ETSI TS 102 593 [3]) and written according to the guidelines of TS 102 514 [16], ISO/IEC 9646-2 [5] and ETS 300 406 [9].

The objective of the present document is to provide a basis for conformance tests for IPv6 equipment giving a high probability of inter-operability between different manufacturers' IPv6 equipments.

- Annex A provides the Tree and Tabular Combined Notation (TTCN-3) part of the ATS.
- Annex B provides the Partial Protocol Implementation Extra Information for Testing (PIXIT) Proforma of the ATS.
- Annex C provides the Protocol Conformance Test Report (PCTR) Proforma of the ATS.

NOTE: Annex B provides only the PIXIT items relevant for the security functions of IPv6. It is therefore necessary to also fill the core PIXIT item in TS 102 516 [15] to gain all PIXIT values needed to run the mobility test campaign.

---

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

- [1] ETSI TS 102 351: "Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT); IPv6 Testing: Methodology and Framework".
- [2] ETSI TS 102 558: "Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT); IPv6 Security; Requirements Catalogue".
- [3] ETSI TS 102 593: "Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT); IPv6 Security; Conformance Test Suite Structure and Test Purposes (TSS&TP)".
- [4] ISO/IEC 9646-1: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts".
- [5] ISO/IEC 9646-2: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 2: Abstract Test Suite specification".
- [6] ISO/IEC 9646-4: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 4: Test realization".
- [7] ISO/IEC 9646-5: "Information technology - Open Systems Interconnection - Conformance testing methodology and Framework - Part 5: Requirements on test laboratories and clients for the conformance assessment process".

- [8] ISO/IEC 9646-6: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 6: Protocol profile test specification".
- [9] ETSI ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".
- [10] ETSI ES 201 873-1: "Methods for Testing and Specification (MTS); The Testing and Test Control Notation version 3; Part 1: TTCN-3 Core Language".
- [11] IETF RFC 4301: "Security Architecture for the Internet Protocol".
- [12] IETF RFC 4302: "IP Authentication Header".
- [13] IETF RFC 4303: "IP Encapsulating Security Payload (ESP)".
- [14] IETF RFC 4306: "Internet Key Exchange (IKEv2) Protocol".
- [15] ETSI TS 102 516: "Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT): IPv6 Core Protocol; Conformance Abstract Test Suite (ATS) and partial Protocol Implementation eXtra Information for Testing (PIXIT) proforma".
- [16] ETSI TS 102 514: "Methods for Testing and Specification (MTS); Internet Protocol Testing (IPT): IPv6 Core Protocol; Requirements Catalogue".

## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**abstract test case:** Refer to ISO/IEC 9646-1 [4].

**Abstract Test Method (ATM):** Refer to ISO/IEC 9646-1 [4].

**Abstract Test Suite (ATS):** Refer to ISO/IEC 9646-1 [4].

**Implementation Under Test (IUT):** Refer to ISO/IEC 9646-1 [4].

**Lower Tester (LT):** Refer to ISO/IEC 9646-1 [4].

**Test Purpose (TP):** Refer to ISO/IEC 9646-1 [4].

### 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AH	Authentication Header
ATM	Abstract Test Method
ATS	Abstract Test Suite
ESP	Encapsulating Security Payload
ETS	Executable Test Suite
IETF	Internet Engineering Task Force
IKE	Internet Key Exchange
IPv6	Internet Protocol version 6
IUT	Implementation Under Test
MOT	Means Of Testing
PCTR	Protocol Conformance Test Report
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
SUT	System Under Test
TC	Test Case

TP	Test Purpose
TSS	Test Suite Structure
TTCN-3	Testing and Test Control Notation version 3
UDP	User Datagram Protocol

## 4 Abstract Test Method (ATM)

The present clause describes the ATM used to test the IPv6 security functions as defined in the RFC specifications [11] through [14]. The two following configurations have been developed to test the two different modes for packet exchange, tunnel mode and transport mode.

### 4.1 IKEv2/AH/ESP Tunnel Mode

CF\_CORE\_01 (TS 102 516 [15] clause 4) is extended with HS02 and used for IKEv2/AH/ESP Tunnel Mode. PTC01 simulates HS02 and RT01. The endpoints of communication are HS02 and NUT. Tunnel Start is RT01, Tunnel End is NUT. In the case where security parameters are negotiated with IKEv2, it is RT01 which negotiates the IKE security association.

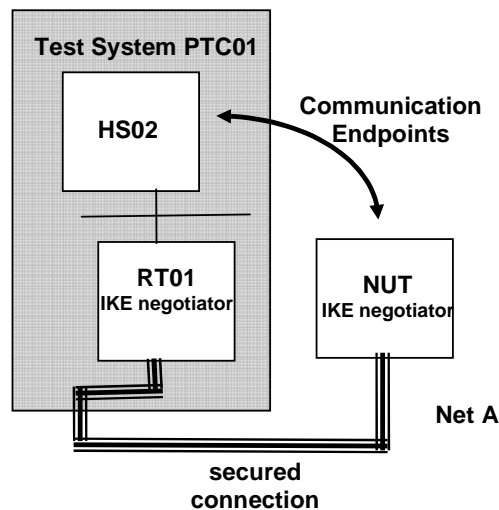


Figure 1: Tunnel Mode

### 4.2 IKEv2/AH/ESP Transport Mode

CF\_CORE\_01 (TS 102 516 [15] clause 4) is extended with HS02 and used for IKEv2/AH/ESP Transport Mode. PTC01 simulates HS02 and RT01. The endpoints of communication are HS02 and NUT. In the case where security parameters are negotiated with IKEv2, it is HS02 which negotiates the IKE security association. RT01 forwards all communication from and to HS02.



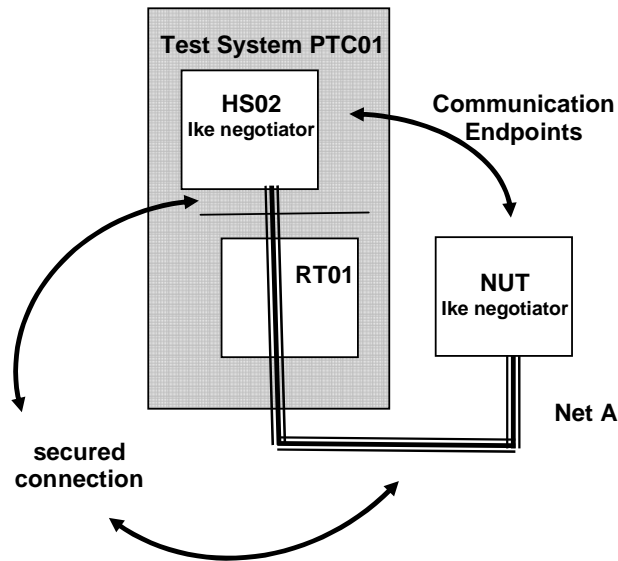


Figure 2: Transport Mode

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## 5 Untestable Test Purposes (TP)

The ATS is comprised of 90 TC. Those were derived from a total of 103 TP.

The following 13 TP are not implemented in the ATS due to the chosen ATM or other restrictions:

TP\_SEC\_2042\_01, TP\_SEC\_3059\_01, TP\_SEC\_3107\_01, TP\_SEC\_3107\_02, TP\_SEC\_3108\_01, TP\_SEC\_3108\_02, TP\_SEC\_3077\_01, TP\_SEC\_3078\_01, TC\_SEC\_6153\_01, TC\_SEC\_6161\_01, TC\_SEC\_6162\_01, TC\_SEC\_6164\_01, TC\_SEC\_6164\_02.

---

## 6 ATS implementation details

The following clauses describe the cleanup procedures used in this ATS.

Descriptions of the ATS conventions are found in TS 102 351 [1]. The ATS implementation details for the IPv6 core test suite, including mapping procedures and ATS value conventions are found in TS 102 516 [15].

### 6.1 Mobility Test Cleanup

#### 6.1.1 Mobility Test Cleanup for MNUT

At the end of each MNUT test case, the MNUT is brought back home as shown in figure 3. In addition, the MNUT's neighbor cache regarding the HA is emptied with the Core Test Cleanup procedure.

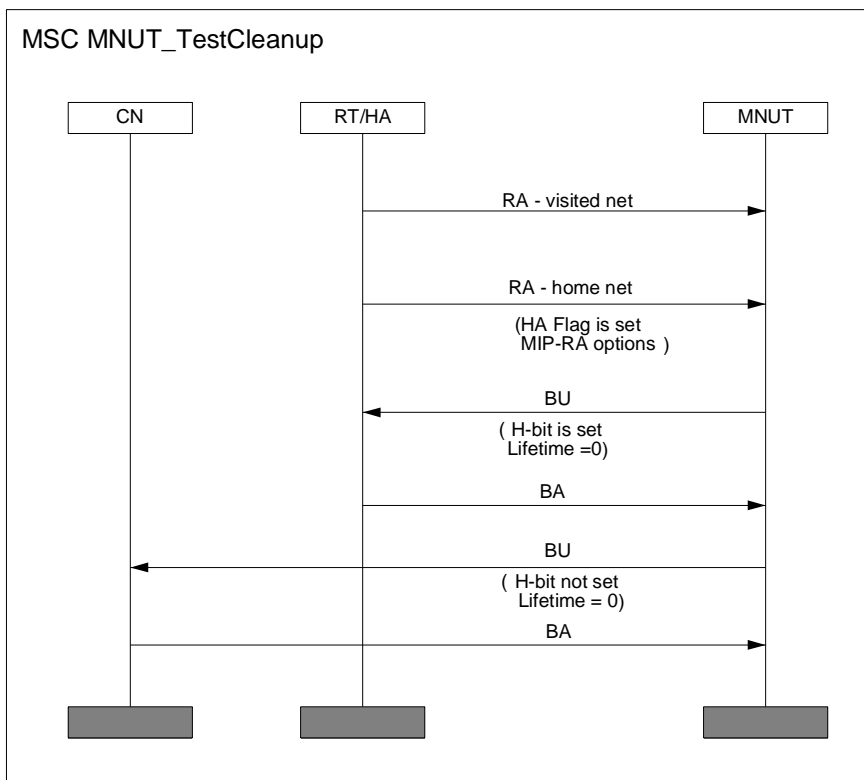


Figure 3: MNUT Test Cleanup

### 6.1.2 Mobility Test Cleanup for HAUT

In order to empty the HAUT's binding cache, the MN sends a BU as shown in figure 4. In addition, the HAUT's neighbor cache regarding the MN is emptied with the Core Test Cleanup procedure.

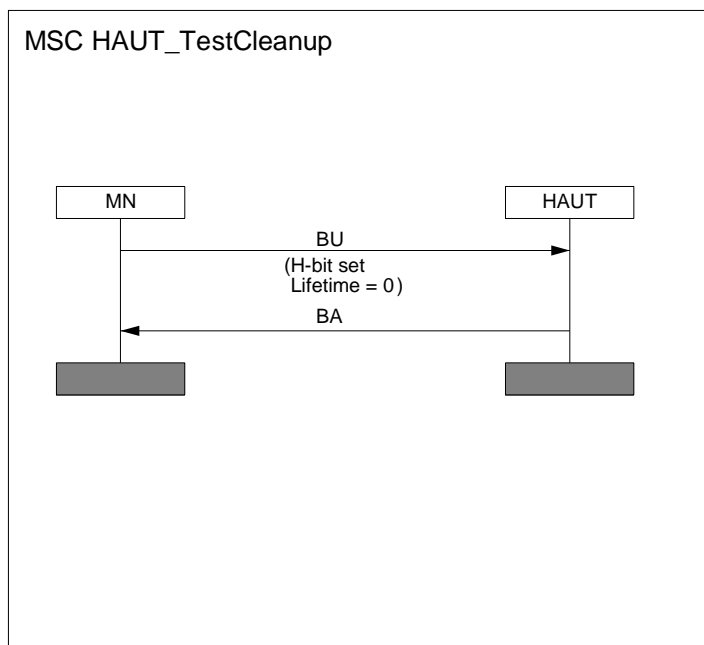


Figure 4: HAUT Test Cleanup

### 6.1.3 Mobility Test Cleanup for CNUT

In order to deregister the MN from the CNUT, the CNUT's binding cache is emptied, by sending a BU from the home network as shown in figure 5. In addition, the CNUT's neighbor cache regarding the HA is emptied with the Core Test Cleanup procedure.

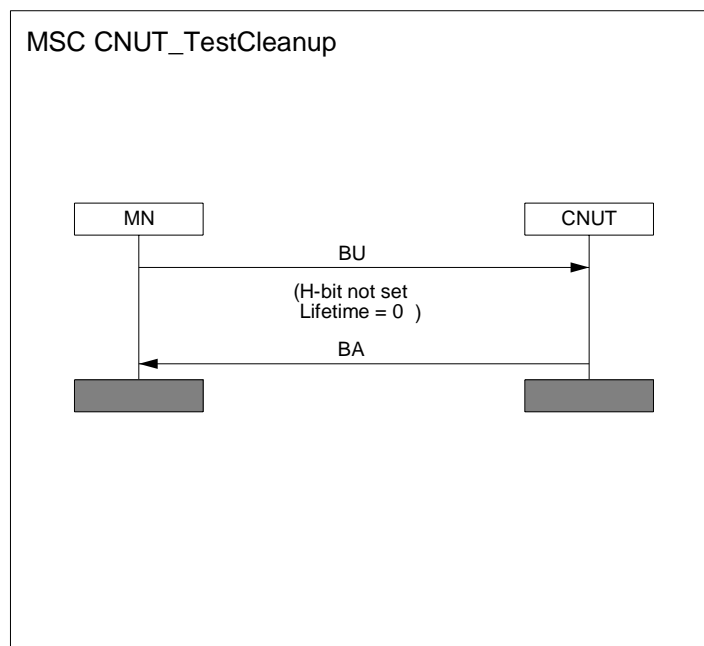


Figure 5: CNUT Test Cleanup

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## 7 PCTR conformance

A test laboratory, when requested by a client to produce a PCTR, is required, as specified in ISO/IEC 9646-5 [7], to produce a PCTR conformant with the PCTR template given in annex B of ISO/IEC 9646-5 [7].

Furthermore, a test laboratory, offering testing for the ATS specification contained in annex C, when requested by a client to produce a PCTR, is required to produce a PCTR conformant with the PCTR proforma contained in annex A.

A PCTR which conforms to this PCTR proforma specification shall preserve the content and ordering of the clauses contained in annex A. Clause A.6 of the PCTR may contain additional columns. If included, these shall be placed to the right of the existing columns. Text in italics may be retained by the test laboratory.

---

## 8 PIXIT conformance

A test realizer, producing an executable test suite for the Abstract Test Suite (ATS) specification contained in annex C, is required, as specified in ISO/IEC 9646-4 [6], to produce an augmented partial PIXIT proforma conformant with this partial PIXIT proforma specification.

An augmented partial PIXIT proforma which conforms to this partial PIXIT proforma specification shall, as a minimum, have contents which are technically equivalent to annex B. The augmented partial PIXIT proforma may contain additional questions that need to be answered in order to prepare the Means Of Testing (MOT) for a particular Implementation Under Test (IUT).

A test laboratory, offering testing for the ATS specification contained in annex C, is required, as specified in ISO/IEC 9646-5 [7], to further augment the augmented partial PIXIT proforma to produce a PIXIT proforma conformant with this partial PIXIT proforma specification.

A PIXIT proforma which conforms to this partial PIXIT proforma specification shall, as a minimum, have contents which are technically equivalent to annex B. The PIXIT proforma may contain additional questions that need to be answered in order to prepare the test laboratory for a particular IUT.

---

## 9 ATS conformance

The test realizer, producing a Means Of Testing (MOT) and Executable Test Suite (ETS) for the present document, shall comply with the requirements of ISO/IEC 9646-4 [6]. In particular, these concern the realization of an Executable Test Suite (ETS) based on each ATS. The test realizer shall provide a statement of conformance of the MOT to the present document.

An ETS which conforms to the present document shall contain test groups and test cases which are technically equivalent to those contained in the ATS in annex C. All sequences of test events comprising an abstract test case shall be capable of being realized in the executable test case. Any further checking which the test system might be capable of performing is outside the scope of the present document and shall not contribute to the verdict assignment for each test case.

Test laboratories running conformance test services using this ATS shall comply with ISO/IEC 9646-5 [7].

A test laboratory which claims to conform to this ATS specification shall use an MOT which conforms to this ATS.

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## Annex A (normative): Abstract Test Suite (ATS)

### A.1 The ATS in TTCN-3 core (text) format

This ATS has been produced using the Testing and Test Control Notation (TTCN-3) according to ES 201 873-1 [10].

The TTCN-3 core (text) representation corresponding to this ATS is contained in several ASCII files contained in archive ts\_102594v010101p0.zip which accompanies the present document.

---

## Annex B (normative): Partial PIXIT proforma

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the PIXIT proforma in this annex so that it can be used for its intended purposes and may further publish the completed PIXIT.

The PIXIT Proforma is based on ISO/IEC 9646-6 [8]. Any needed additional information can be found in there.

---

### B.1 Identification summary

Table B.1

<b>PIXIT Number:</b>	
<b>Test Laboratory Name:</b>	
<b>Date of Issue:</b>	
<b>Issued to:</b>	

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### B.2 ATS summary

Table B.2

<b>Protocol Specification:</b>	
<b>Protocol to be tested:</b>	
<b>ATS Specification:</b>	
<b>Abstract Test Method:</b>	

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### B.3 Test laboratory

Table B.3

<b>Test Laboratory Identification:</b>	
<b>Test Laboratory Manager:</b>	
<b>Means of Testing:</b>	
<b>SAP Address:</b>	

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### B.4 Client identification

Table B.4

<b>Client Identification:</b>	
<b>Client Test manager:</b>	
<b>Test Facilities required:</b>	

## B.5 SUT

Table B.5

<b>Name:</b>	
<b>Version:</b>	
<b>SCS Number:</b>	
<b>Machine configuration:</b>	
<b>Operating System Identification:</b>	
<b>IUT Identification:</b>	
<b>PICS Reference for IUT:</b>	
<b>Limitations of the SUT:</b>	
<b>Environmental Conditions:</b>	

## B.6 Protocol layer information

NOTE: The tables below provide only the PIXIT items relevant for the security functions of IPv6. It is therefore necessary to also fill the core PIIXT item in TS 102 516 [15] to gain all PIXIT values needed to run the mobility test campaign.

### B.6.1 Protocol identification

Table B.6

<b>Name:</b>	
<b>Version:</b>	
<b>PICS References:</b>	

### B.6.2 UDP ports

Table B.7: UDP ports

<b>Name</b>	<b>Type</b>	<b>Comments</b>	<b>Value</b>
<b>PX_UDP_PORT_IUT_1</b>	500 or 4500	UDP Port of IUT	
<b>PX_UDP_PORT_HS02</b>	500 or 4500	UDP Port of tester	

## B.6.3 Security Parameters

### B.6.3.1 AH and ESP testing

**Table B.8: Security parameters – AH and ESP**

Name	Type	Comments	Value
PX_IP_SEC_PROTOCOL_MODE	Transport Mode or Tunnel Mode	Which protocol mode (tunnel or transport) shall be used?]	
PX_ENCRYPTION_ALGO	Encryption Algorithm	Which Algorithm shall be used for Encryption?	
PX_INTEGRITY_ALGO	Integrity Algorithm	Which Algorithm shall be used for Encryption?	
PX_SPI	Integer	Which SPI value shall be used for testing?	
PX_ESP_ENCR_KEY	octetstring	Encryption Key	
PX_INTEGRITY_KEY	octetstring	Integrity Key	
PX_IPSEC_CONTROL	Manual or IKE	Are security parameters configured manually or is IKE used to negotiate security parameters?	
PX_ENCALGO_UNACCEPTABLE	Encryption Algorithm	Which SA encryption algorithm is not acceptable for the IUT?	
PX_INTALGO_UNACCEPTABLE	Integrity Algorithm	Which SA integrity algorithm is not acceptable for the IUT?	

### B.6.3.2 IKEv2 testing

**Table B.9: Security parameters - IKE**

Name	Type	Comments	Value
PX_IKE_SPI	octetstring [8]	Which SPI shall be used for testing IKE?	
PX_AH_OR_ESP	ESP or AH	Which protocol (ESP or AH) shall be requested in IKE_AUTH messages when testing IKE?	
PX_IKE_ENCALGO	Encryption Algorithm	Which encryption algorithm shall be used for testing IKE?	
PX_IKE_PSEUDORANDOM_FCT	Pseudo Random Function	Which pseudo random function shall be used for testing IKE?	
PX_IKE_INTALGO	Integrity Algorithm	Which integrity algorithm shall be used for testing IKE?	
PX_IKE_DIFFIEHELLMAN_GROUP	Diffie-Hellman Group	Which Diffie-Hellman group shall be used for testing IKE?	
PX_IKE_DIFFIEHELLMAN_PRIVATE_KEY	octetstring	Which private key for the Diffie-Hellman exchange shall be used for testing IKE?	
PX_PRE_SHARED_KEY	octetstring	Which pre-shared secret shall be used for calculating the AUTH value?	
PX_IDENTIFICATION_DATA	octetstring	Which identification data (type = ID_IPV6_ADDR) shall be used for sending in Identification payloads?	
PX_IKE_ENCALGO_UNACCEPTABLE	Encryption Algorithm	Which IKE_SA encryption algorithm is not acceptable for the IUT?	
PX_IKE_PSEUDORNDFACT_UNACCEPTABLE	Pseudo Random Function	Which IKE_SA pseudo random function is not acceptable for the IUT?	
PX_IKE_INTALGO_UNACCEPTABLE	Integrity Algorithm	Which IKE_SA integrity algorithm is not acceptable for the IUT?	
PX_TEST_EAP	Boolean	Selects only TCs that have the test condition "IUT configured to support EAP".	
PX_TEST_IPCOMP	Boolean	Selects only TCs that have the test condition "IUT configured to support IPCOMP"	
PX_TEST_IKE_AUTH_CFGPL	Boolean	Selects only TCs that have the test condition "IUT configured to expect IKE_AUTH request to include the Configuration Payload"	



## B.6.4 Unknown IDs

**Table B.10: Unknown IDs**

<b>Name</b>	<b>Type</b>	<b>Comments</b>	<b>Value</b>
PX_UNRECOGNISED_PAYLOAD	Integer	An IKEv2 payload identifier that is unrecognized by the IUT.	

## Annex C (normative): PCTR proforma

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the PCTR proforma in this annex so that it can be used for its intended purposes and may further publish the completed PCTR.

The PCTR proforma is based on ISO/IEC 9646-6 [8]. Any needed additional information can be found in there.

### C.1 Identification summary

#### C.1.1 Protocol conformance test report

**Table C.1**

PCTR Number:	
PCTR Date:	
Corresponding SCTR Number:	
Corresponding SCTR Date:	
Test Laboratory Identification:	
Test Laboratory Manager:	
Signature:	

#### C.1.2 IUT identification

**Table C.2**

Name:	
Version:	
Protocol specification:	
PICS:	
Previous PCTR if any:	

#### C.1.3 Testing environment

**Table C.3**

PIXIT Number:	
ATS Specification:	
Abstract Test Method:	
Means of Testing identification:	
Date of testing:	
Conformance Log reference(s):	
Retention Date for Log reference(s):	

## C.1.4 Limits and reservation

Additional information relevant to the technical contents or further use of the test report, or the rights and obligations of the test laboratory and the client, may be given here. Such information may include restriction on the publication of the test report.

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## C.1.5 Comments

Additional comments may be given by either the client or the test laboratory on any of the contents of the PCTR, for example, to note disagreement between the two parties.

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## C.2 IUT Conformance status

This IUT has or has not been shown by conformance assessment to be non conforming to the specified protocol specification.

*Strike the appropriate words in this sentence. If the PICS for this IUT is consistent with the static conformance requirements (as specified in clause C.3) and there are no "FAIL" verdicts to be recorded (in clause C.6) strike the words "has or", otherwise strike the words "or has not".*

---

## C.3 Static conformance summary

The PICS for this IUT is or is not consistent with the static conformance requirements in the specified protocol.

*Strike the appropriate words in this sentence.*

---

## C.4 Dynamic conformance summary

The test campaign did or did not reveal errors in the IUT.

*Strike the appropriate words in this sentence. If there are no "FAIL" verdicts to be recorded (in clause C.6t) strike the words "did or" otherwise strike the words "or did not".*

Summary of the results of groups of test:

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## C.5 Static conformance review report

If clause C.3 indicates non-conformance, the present clause itemizes the mismatches between the PICS and the static conformance requirements of the specified protocol specification.

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## C.6 Test campaign report

Table C.4

ATS Reference	Selected?	Run?	Verdict	Observations
<b>Group 1 Authentication Header (AH)</b>				
TP_SEC_2000_01				
TP_SEC_2000_02				
TP_SEC_2000_03				
TP_SEC_2000_04				
TP_SEC_2009_01				
TP_SEC_2046_01				
TP_SEC_2053_01				
TP_SEC_2057_01				
TP_SEC_2058_01				
<b>Group 2 Encapsulating Security Payload (ESP)</b>				
TP_SEC_3030_01				
TP_SEC_3059_01				
TP_SEC_3061_01				
TP_SEC_3068_01				
TP_SEC_3080_01				
TP_SEC_3083_01				
TP_SEC_3102_01				
TP_SEC_3102_02				
TP_SEC_3103_01				
TP_SEC_3103_02				
<b>Group 3 Key Exchange (IKEv2) Protocol</b>				
Group 3.1 Exchange Message Structures				
TP_SEC_6400_01				
TP_SEC_6401_01				
TP_SEC_6403_01				
TP_SEC_6405_01				
TP_SEC_6407_01				
TP_SEC_6409_01				
TP_SEC_6411_01				
TP_SEC_6412_01				
Group 3.2 IKE Header and Payload Formats				
Group 3.2.1 Configuration payload				
TP_SEC_6468_01				
Group 3.2.2 IKE Error Types				
TP_SEC_6365_01				
TP_SEC_6375_01				
TP_SEC_6376_01				
TP_SEC_6379_01				
TP_SEC_6393_01				
TP_SEC_6394_01				
Group 3.3 IKE Informational Exchanges				
TP_SEC_6007_01				
TP_SEC_6014_01				
TP_SEC_6014_02				
Group 3.4 IKE Protocol				
Group 3.4.1 Authentication				
Group 3.4.1.1 Extensible Authentication Methods				
TP_SEC_6151_01				
TP_SEC_6152_01				
TP_SEC_6153_01				
TP_SEC_6161_01				
TP_SEC_6162_01				
TP_SEC_6164_01				
TP_SEC_6164_02				
Group 3.4.2 Error Handling				
TP_SEC_6186_01				
TP_SEC_6186_02				
TP_SEC_6188_01				

ATS Reference	Selected?	Run?	Verdict	Observations
TP_SEC_6188_02				
TP_SEC_6189_01				
TP_SEC_6189_02				
TP_SEC_6023_01				
TP_SEC_6023_02				
TP_SEC_6023_03				
Group 3.4.3 General Protocol Handling				
Group 3.4.3.1 Address and Port Agility				
TP_SEC_6206_01				
Group 3.4.3.2 IP Compression (IPComp)				
TP_SEC_6385_01				
Group 3.4.3.3 Message Format				
TP_SEC_6369_01				
TP_SEC_6369_02				
Group 3.4.3.4 Overlapping Requests				
TP_SEC_6041_01				
TP_SEC_6041_02				
Group 3.4.3.5 Request Internal Address				
TP_SEC_6177_01				
TP_SEC_6184_01				
Group 3.4.3.6 Retransmission Timers				
TP_SEC_6030_01				
TP_SEC_6030_02				
TP_SEC_6030_03				
TP_SEC_6030_04				
TP_SEC_6033_01				
TP_SEC_6033_02				
TP_SEC_6033_03				
TP_SEC_6033_04				
Group 3.4.3.7 Version Compatibility				
TP_SEC_6065_01				
TP_SEC_6065_02				
TP_SEC_6065_03				
TP_SEC_6065_04				
TP_SEC_6068_01				
TP_SEC_6068_02				
TP_SEC_6068_03				
TP_SEC_6068_04				
TP_SEC_6362_01				
TP_SEC_6362_02				
TP_SEC_6073_01				
TP_SEC_6073_02				
Group 3.4.4 Security Parameter Negotiation				
Group 3.4.4.1 Algorithm Negotiation				
TP_SEC_6088_01				
TP_SEC_6088_02				
TP_SEC_6088_03				
TP_SEC_6372_01				
TP_SEC_6372_02				
TP_SEC_6372_03				
TP_SEC_6373_01				
Group 3.4.4.2 Cookies				
TP_SEC_6081_01				
Group 3.4.4.3 Rekeying				
TP_SEC_6101_01				
TP_SEC_6102_01				
TP_SEC_6103_01				
TP_SEC_6105_01				
Group 3.4.4.4 Traffic Selector Negotiation				
TP_SEC_6123_01				
TP_SEC_6125_01				

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## C.7 Observations

Additional information relevant to the technical content of the PCTR is given here.

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## History

<b>Document history</b>		
V1.1.1	May 2007	Publication